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*Published in:*  
Memory

*DOI:*  
[10.1080/09658211.2019.1616097](https://doi.org/10.1080/09658211.2019.1616097)

**IMPORTANT NOTE:** You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

*Document Version*  
Publisher's PDF, also known as Version of record

*Publication date:*  
2019

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*

Talarico, J. M., Bohn, A., & Wessel, I. (2019). The role of event relevance and congruence to social groups in flashbulb memory formation. *Memory*, 27(7), 985-997 . <https://doi.org/10.1080/09658211.2019.1616097>

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To cite this article: Jennifer M. Talarico, Annette Bohn & Ineke Wessel (2019) The role of event relevance and congruence to social groups in flashbulb memory formation, *Memory*, 27:7, 985-997, DOI: [10.1080/09658211.2019.1616097](https://doi.org/10.1080/09658211.2019.1616097)

To link to this article: <https://doi.org/10.1080/09658211.2019.1616097>



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# The role of event relevance and congruence to social groups in flashbulb memory formation

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## ABSTRACT

Flashbulb memories are vivid, confidently held, long-lasting memories for the personal circumstances of learning about an important event. Importance is determined, in part, by social group membership. Events that are relevant to one's social group, and furthermore, are congruent with the prior beliefs of that group, should be more likely to be retained as flashbulb memories. The Fukushima nuclear disaster was relevant to ongoing political conversations in both Germany and the Netherlands, but, while the disaster was congruent with German beliefs about the dangers of nuclear energy, it was incongruent with Dutch support for nuclear power. Danish participants would not have found the disaster to be particularly relevant. Partially consistent with this prediction, across two samples ( $N = 265$  and  $N = 518$ ), German participants were most likely to have flashbulb memories for the Fukushima disaster. Furthermore, event features thought to be related to flashbulb memory formation (e.g. ratings of importance and consequentiality) also differed as a function of nationality. Spontaneously generated flashbulb memories for events other than Fukushima also suggested that participants reported events that were relevant to national identity (e.g. the Munich attacks for Germans, the Utøya massacre for Danes, and Malaysian Airlines flight MH-17 for Dutch participants).

## ARTICLE HISTORY

Received 26 March 2018  
Accepted 30 April 2019

## KEYWORDS

Flashbulb memory; social identity; Fukushima nuclear disaster

Flashbulb memories are memories for the personal circumstances of learning about an important event. As such, flashbulb memories refer to events which individuals experience only indirectly.<sup>1</sup> As Talarico and Rubin (2017) stated, "long-lasting, detailed, vivid, confidently-held memories of directly-experienced, emotional, important, and well-rehearsed events are not unexpected, but the idea that simply receiving news can change a mundane experience into a noteworthy memory remains surprising" (p. 89) and this is, at least in part, why flashbulb memories continue to capture the attention of psychologists and laypersons alike. In search of an explanation, Neisser (1982) suggested that "we remember the details of a flashbulb occasion because those details are the links between our own histories and 'History'" (p. 48). Building on this, Berntsen (2009) argued that it is relevance to one's social group that first draws a person's attention to the event itself and leads to the emotional appraisal and interpretation of importance that further serve to support flashbulb memory formation. Many models of flashbulb memory formation identify appraisals of the event (e.g. emotional intensity and consequentiality) as determinants of enhanced phenomenology (i.e. vividness, confidence in the accuracy of the memory) (e.g. Brown & Kulik, 1977; Finke et al., 1998; Luminet & Curci, 2009). Yet, Berntsen's

model emphasizes that social identity leads to these appraisals and serves to create and maintain flashbulb memories.

There is some evidence in support of Berntsen's model where social identity denotes personal significance. A study of memories for the death of Michael Jackson found that social bond to the performer (i.e. a sense of connectedness or personal significance) lead to surprise upon the announcement of his death, increased emotional intensity in response to the news, and enhanced rehearsal, all of which predicted participants' confidence in the accuracy of their flashbulb memories (Day & Ross, 2014). Similarly, a study on the functions of different types of autobiographical memories found that participants rated flashbulb memories as the memories that they shared most often with others (Rasmussen & Berntsen, 2009) supporting the claim that social relevance increases rehearsal. More broadly, social group membership is associated with which events individuals are most likely to retain. Brown and Kulik's (1977) seminal work showed that Black Americans were more likely to develop flashbulb memories for public events from the 1960s that were important to the civil rights movement than were White Americans. More recent work also showed that public events were more likely to lead to flashbulb memories in a domestic population than an

international one (Curci, Luminet, Finkenauer, & Gisler, 2001; Kvavilashvili, Mirani, Schlagman, & Kornbrot, 2003).

If an event is irrelevant to one's self or social group, there is no reason to expect a flashbulb memory in response to learning of that event; relevance for one's social group is a necessary (though not sufficient) criterion for a flashbulb memory. Relevance draws attention to the event, engenders appraisal processes that lead to emotional reactions, and sustains attention for subsequent rehearsal. Social groups further provide opportunities to discuss an event of mutual interest and therefore encourage elaborative rehearsal processes. Traditionally, flashbulb memory research focuses on covert (i.e. thoughts about the event) and overt (i.e. talking or writing about the event) personal rehearsal. However, rehearsal may also include an individual's engagement with public media (i.e. watching television and/or reading news accounts) or measures of general public consciousness (i.e. public opinion). Most interesting for flashbulb memory research is the process of "rehearsal displacement" suggested by Larsen (1992, p. 62), wherein the event itself is not the central focus of rehearsal, instead it is the personal circumstances of learning about the event that is rehearsed and the news event becomes merely a cue to that memory. Although the relative importance of these forms of rehearsal may depend on the time of assessment (e.g. media coverage will be highest as the event unfolds and in the immediate aftermath and then decrease with time), all are likely to support flashbulb memory formation.

The downside of these elaborative rehearsals is that they may also allow cognitive biases to become introduced to flashbulb memories. For example, rehearsal may invite confirmation bias, meaning that individuals deny, diminish, or distort aspects of an event that disconfirm their pre-existing beliefs, values, and/or schemas. Studies of memory for sporting events have shown dramatic effects of social group membership on factual recall of game details (e.g. Hastorf & Cantril, 1954). Fans of winning teams tend to recall games more accurately (Breslin & Safer, 2011; Talarico & Moore, 2012), a result demonstrating a bias towards remembering details that enhance the image of the group. Importantly, although individuals typically seek to maintain a positive self-image and positive associations with their social group (i.e. a social desirability bias), negative events can serve to confirm prior beliefs (e.g. a plane crash confirms planes as a dangerous mode of transportation in individuals with a fear of flying). Further, post-event interpretations can reframe negative events more positively (e.g. patriotism in the wake of terrorist attacks). Given that the preponderance of flashbulb memory research is in the wake of negative public events, it would be unwise to conflate confirmation with positive affect. Yet, events that are consistent with a positive self-image (or positive image of the social group) are more likely to lead to flashbulb memories than are those that disconfirm positive beliefs about the self or social group (Berntsen & Thomsen, 2005; Bohn & Berntsen, 2007).

Therefore, we can identify two dimensions which should predict flashbulb memory formation for a given event: relevance and congruence. Relevance to one's social group would be a necessary first criterion. Once relevance has been established, the congruence of an event with one's pre-existing beliefs has an opportunity to exert influence. If an event is congruent with one's beliefs, then we would expect greater flashbulb memory frequency. If an event is incongruent with one's beliefs, then we would expect flashbulb memory formation to be inhibited. These effects, again, would occur within the context of an event that is relevant to the social group.

Predictions regarding the relative influence of relevance and congruence have yet to be examined in the flashbulb memory literature. A unique opportunity to do so was the Fukushima Daiichi nuclear disaster of 11 March 2011. This event was rated as a worst possible nuclear accident by the International Atomic Energy Agency. It accommodates comparing participants from relatively similar countries with different relationships to nuclear energy to see how dominant public perceptions influence the likelihood of individuals' developing flashbulb memories for the same event. To the extent that culture can shape how emotional appraisals and rehearsal mechanisms operate to support flashbulb memory formation (Wang & Aydin, 2017), these countries should not differ in general cultural terms (e.g. individualistic vs. collectivistic). Countries that allow for such a comparison are Germany, the Netherlands, and Denmark. Because the event occurred more than 9000 km away and more than five years before we asked our participants for their memories, it provides a strong test of the flashbulb memory hypothesis. Therefore, we expect rare, but reliably different rates of flashbulb memory incidence in our three samples. Specifically, we argue that Germans are more likely to have flashbulb memories than are Dutch participants who are, in turn, more likely to have flashbulb memories than the Danes. Eurobarometer (European Commission, 2011a, 2011b, 2011c) data indicate that, relative to an EU27 baseline of 2%, 5% of Germans, 3% of Dutch, and 4% of Danes think that "energy supply" is one of "the two most important issues facing [their country]." In response to the question, "personally, what are the two most important issues you are facing," 24% of Germans, 8% of Dutch, and 7% of Danish respondents selected "energy costs" relative to an EU rate of 12% (European Commission, 2011a, 2011b, 2011c).

Germany has a long history of incorporating nuclear power into domestic energy policy. According to the History of Nuclear Energy and Society (HoNESt, 2017) report, both Soviet imports in the former German Democratic Republic (East Germany) and the industrial businesses in the former Federal Republic of Germany (West Germany) contributed to modern Germany's reliance on nuclear energy. The World Nuclear Association reports that "public opinion in Germany remains broadly opposed to nuclear power" (<http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/germany.aspx>). Phase-out

plans have been periodically introduced by the German government, with the most recent one being a direct result of public uprising in the wake of the Fukushima disaster (Breidthardt, 2011). The Fukushima disaster is explicitly mentioned in the revised government policy as a reason to “speed up” the process of fading out nuclear energy (Die Bundesregierung, 2018), underscoring that, at the time of the disaster, energy policy was an important political issue. This suggests that Germans are highly likely to have flashbulb memories for the Fukushima disaster as it was highly relevant to national concerns and it further confirmed public opinion that nuclear energy is dangerous.

The Netherlands’ relationship to nuclear energy provides the critical case where the event was relevant to the social group, but incongruent with popular opinion. Currently, the Netherlands has one nuclear power plant (Borssele) providing 3%–4% of the total yearly production of electricity and heat in the country (Central Bureau of Statistics, 2017). Opposition in the 1970s and 1980s led to cancellation of plans to build new plants (Stichting Laka, 2018a). Nevertheless, with the growing threat of global warming, there was greater acceptance of a role for nuclear energy in the move away from fossil fuel (HoNESt, 2017) in the years just before the Fukushima disaster. For example, the government taking office in 2010 explicitly stated that new permits would be issued to build nuclear power plants (CDA-VVD, 2010). Around that time, plans for a second plant (Borssele 2) were well underway (Stichting Laka, 2018b). As for public opinion, the results of a small-scale Dutch survey ( $N = 123$ ) in early 2009 show that respondents rated an increase of the use of nuclear energy in the Netherlands as moderately acceptable (de Groot, Steg, & Poortinga, 2013). Thus, around the time of the Fukushima disaster, the general attitude towards nuclear energy in The Netherlands would have been permissive. Therefore, the Fukushima nuclear disaster would be relevant to a Dutch participant, as with the Germans, but the event would be incongruent with Dutch beliefs about nuclear energy, in contrast to German participants’ reactions.

Lastly, Denmark has never introduced commercial nuclear energy (HoNESt, 2017). According to the World Nuclear Association, there is broad political consensus to maintain that status quo (<http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/denmark.aspx>). Because energy policy is relatively consistent across the major political parties, it is not a dominant issue in Danish political discourse. Therefore, we would expect few Danes to develop flashbulb memories for the Fukushima nuclear disaster.

In sum, we expect flashbulb memories for the Fukushima Daiichi nuclear disaster of 11 March 2011 to be most prevalent in German participants, less frequent among Dutch, and most rare in Danish participants. Due to the absence of nuclear power in Denmark, Danes would have likely found the event largely irrelevant to their national interests and are therefore unlikely to have had much sustained

attention, emotional reaction, or elaborative rehearsal opportunities available to develop flashbulb memories. The former two groups would have found the event relevant to ongoing national concerns, but only the Germans would have identified the meltdown as being consistent with popular opinion about the dangers of nuclear energy. Dutch participants would have been more inclined to view the event as less threatening, consistent with a supportive climate for nuclear power in their country.

Moreover, we may see differences among the flashbulb memories held by each group due to those same social factors of relevance and congruence. For instance, given the relative absence of public attention to the event, even Danes who have flashbulb memories may retrospectively rate the importance of the event as lower than the Dutch and German participants. Similarly, because the event was congruent with German public opinion about the dangers of nuclear energy, flashbulb memories among those participants may include higher ratings of emotional intensity than will flashbulb memories of Dutch participants. Again, we would assume objectively high ratings on both dimensions from all participants with flashbulb memories, but there may be relative differences that are still observable among groups.

## Study 1

### Method

#### Participants

University students from all three nationalities were recruited to participate in an online questionnaire (Qualtrics, 2017) during the fall of 2016 and spring of 2017 (approximately 5 years after the disaster occurred). Ethics board approval was obtained from the questionnaire-hosting institution (Lafayette College). University of Groningen participants (from both Netherlands and Germany) earned course credit for participation; Aarhus University (Danish) participants were volunteers.

A total of 331 participants began the questionnaire, 66 of whom were excluded from data analysis. The majority of participants were excluded for failing to complete the instrument ( $n = 61$ , 3 from the Netherlands, 2 from Germany, and 56 from Denmark). The remainder were excluded for failing one of the catch trials as described below ( $n = 2$ , both from Denmark) or for being born before 1990 ( $n = 3$ , 1 from Netherlands and 2 from Denmark).<sup>2</sup> Of the 265 participants included in the final analysis, 105 were from Netherlands, 105 were from Germany, and 55 were from Denmark.

All remaining participants were born between 1990 and 1999 (aged 18–27). According to Tukey HSD tests, the Dutch participants ( $M = 20.43$  years old,  $SD = 1.56$ ) were significantly younger than the German ( $M = 21.15$  years old,  $SD = 1.50$ ) and Danish ( $M = 21.60$  years old,  $SD = 1.75$ ) participants who were not different from each other,  $F(2, 262) = 11.29$ ,  $p < .001$ . We do not believe this statistical difference to be practically meaningful and therefore did

not include age in any subsequent analysis. All groups were predominantly female (male participants included  $n = 22$ , 21% Dutch,  $n = 22$ , 21%, German, and  $n = 5$ , 9% Danish) and there was no significant difference among groups in terms of gender,  $\chi^2(2, N = 265) = 4.07, p = .13$ .

### Design and procedure

A one-way between-groups design was used to assess flashbulb memory characteristics across the three national samples. All participants completed the same online questionnaire, translated from English to Danish, German, or Dutch (as appropriate) by the second and last authors. The online instrument included an informed consent page at the outset and a debriefing statement upon completion.

### Availability of materials and data

The materials and data for study 1 are publicly available from <https://osf.io/hpkwj/>. We report all measures and data exclusions.

### Questionnaire

The instrument began with a yes/no question as to whether the participant had a flashbulb memory for the Fukushima disaster, "Do you remember where you were and what you were doing when you learned of the Fukushima nuclear disaster in Japan on March 11, 2011?" On the same page, they were also asked, "Is there another public event, recent or remote, for which you remember exactly where you were and what you were doing when you learned of that news?" and, if yes, to provide a brief description of that event. This was a control question to assess familiarity with the phenomenon and whether all groups were equally likely to have flashbulb memories overall.

The questionnaire was branched from the first question such that only those participants who answered "yes" to the dichotomous Fukushima question were then presented with a series of nine probed recall questions about the canonical details of that event (Kızılöz & Tekcan, 2013). Specifically, they were asked: (1) Who or what first told you that the Fukushima nuclear disaster had occurred? (2) Where were you when you first learned the news? (3) When did you first learn the news? (4) Was anyone else present when you first heard the news, and, if so, who? (5) What were you doing immediately before you first heard the news? (6) What did you do immediately after you first heard the news? (7) What was your dominant emotion when you first heard the news? (8) What was your primary thought when you first heard the news? (9) Are there any other distinctive details you remember from when you first heard the news?

The next page then asked them a series of 7-point rating-scale questions about phenomenological and meta-cognitive aspects of their memory drawn from the Autobiographical Memory Questionnaire (AMQ; Rubin, Schrauf, & Greenberg, 2003). Participants were asked to rate how vivid their memory was and how much they felt they were reliving the event (both rated from 1-not

at all to 7-as clearly as if it were happening now). They were asked to rate their belief in the accuracy of their memory (from 1-100% imaginary to 7-100% accurate). They also rated the emotional valence (from -3-negative to 3-positive which was transformed to the same 7-point scale as other measures with 1 being negative and 7 being positive) and emotional intensity (from 1-not at all intense to 7-extremely intense) while remembering the event. The personal significance of the event was rated (from 1-not at all to 7-more than any other memory). Lastly, three types of rehearsal of the flashbulb memory were rated, thinking and talking about the personal circumstances of hearing about the event as well as attending to media about the Fukushima disaster (all from 1-not at all to 7-more than any other event).

All participants, regardless of their answer to the first question, were asked to assess how surprising, important, and consequential the Fukushima disaster itself was. For surprise, there was one question with a scale from 1-not at all to 7-completely. They were asked to assess the importance to themselves personally, to their family and friends, to their country, and internationally (all from 1-not at all to 7-more than any other event). They were similarly asked to rate the political, environmental, and economic consequences as well as the extent to which it influenced their daily life (all from 1-not at all to 7-more than any other event). They were also asked about their beliefs about nuclear energy both "prior to this event" and "after this event." A 4-point scale was used with options to "strongly" or "somewhat" "oppose" or "favor" the "use of nuclear energy as one way to provide electricity."

Two catch trials were also included, one during the AMQ and one between the event assessment questions and the nuclear energy beliefs questions that asked participants to select a specific choice option. (e.g. "please select "2" for this question").

Lastly, participants were asked their gender, year of birth, and their nationality, what country they lived in, and how long they had lived there.

## Results

### Flashbulb memory formation for the Fukushima disaster by nationality group

First, using the dichotomous self-identified flashbulb memory question at the start of the questionnaire, we assessed our primary hypothesis that flashbulb memory formation would depend, in part, on nationality. There was a significant association between nationality and flashbulb memory formation for the Fukushima nuclear disaster,  $\chi^2(2, N = 265) = 14.10, p = .001$ . Germans were more likely to report flashbulb memories for the Fukushima disaster (17%,  $n = 18/105$ ) than were Dutch (3%,  $n = 3/105$ ) or Danes (5%,  $n = 3/55$ ). Participants with flashbulb memories remembered on average 7.87 canonical categories (range 1-9;  $SD = 1.90$ ), indicating that the memories were quite detailed (see Table 1).



**Table 1.** Descriptive statistics of the phenomenological and metacognitive characteristics among participants reporting flashbulb memories for the Fukushima nuclear disaster in Study 1.

	German ( <i>n</i> = 18)				Dutch ( <i>n</i> = 3)		Danish ( <i>n</i> = 3)	
	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>Values</i>	<i>M</i>	<i>Values</i>
Vividness	4.50	1.25	2	7	2.33	2, 2, 3	2.33	2, 2, 3
Reliving	3.39	1.38	1	7	2.00	1, 2, 3	1.33	1, 1, 2
Belief in Accuracy	4.11	1.28	3	7	3.00	2, 3, 4	3.00	1, 3, 5
Emotional Valence	2.28	1.13	−3	1	3.33	−1, −1, 0	3.67	−1, 0, 0
Emotional Intensity	3.89	1.64	1	6	1.67	1, 2, 2	1.67	1, 2, 2
Personal Significance	3.00	1.61	1	6	1.33	1, 1, 2	1.00	1, 1, 1
Covert Rehearsal	2.00	.84	1	4	2.00	1, 2, 3	1.67	1, 1, 3
Overt Rehearsal	4.56	1.76	1	7	1.67	1, 2, 2	2.00	1, 2, 3
Media Rehearsal	4.11	1.37	1	6	3.33	2, 4, 4	2.00	1, 2, 3
Canonical Categories	8.50	.86	6	9	6.33	4, 7, 8	5.67	1, 8, 8

### *Fukushima flashbulb memory characteristics by nationality group*

Because of the low numbers of flashbulb memories in the Dutch and Danish groups, statistical analyses of group differences in phenomenological and metacognitive characteristics of those flashbulb memories would be difficult to interpret. We therefore report descriptive statistics for those variables in Table 1. As can be seen in this table, among those participants with flashbulb memories of Fukushima, the Germans' ratings seem to be numerically higher than the ratings of the Dutch and the Danish.

### *Fukushima event features by nationality group*

We also compared participants from each national group on their support for nuclear energy to test the assumption that our samples would reflect the population trends in public opinion. A one-way between-subjects ANOVA found a significant effect of group for support of nuclear energy both prior to and after the Fukushima disaster,  $F(2, 257) = 11.50, p < .001, \eta_p^2 = .082$  and  $F(2, 257) = 19.37, p < .001, \eta_p^2 = .131$  respectively. According to post-hoc Tukey HSD tests, Dutch participants (prior:  $M = 2.37, SD = .61$ ; after:  $M = 2.03, SD = .75$ ) had significantly higher support for nuclear energy than did Danish (prior:  $M = 2.00, SD = .76$ ; after:  $M = 1.62, SD = .73$ ) and German (prior:  $M = 1.93, SD = .74$ ; after:  $M = 1.41, SD = .70$ ) participants, who were not significantly different from one another. (As a reminder, scores of 2 and below indicated opposition to nuclear energy.)

Further, we examined whether national groups would differ on event features thought to be predictive of flashbulb memory formation and conducted a series of nine one-way ANOVA on ratings of surprise, importance, and consequentiality. To correct for multiple comparisons, we adjusted the alphas following a sequential Bonferroni procedure (Cramer et al., 2016). Significant main effects were followed up with Tukey HSD tests. As shown in Table 2, there was no statistically significant difference among groups on ratings of surprise or international importance. All other importance and consequentiality variables did show an effect of nationality. Germans rated the personal importance and the effect of the event on their daily life as well as the political, environmental, and economic consequences significantly higher than the Dutch or Danes (who were not different from each other). Germans also rated the importance of the event to their family and friends and the national importance of the event significantly higher than the Dutch who, in turn, rated those aspects of importance more highly than did the Danes.

### *Non-Fukushima flashbulb memories*

Most participants reported having flashbulb memories for some other event: 63% ( $n = 66/105$ ) of Germans, 70% ( $n = 73/105$ ) of Dutch, and 80% ( $n = 44/55$ ) of Danes and there was no statistically significant difference among the groups,  $\chi^2(2, N = 265) = 4.98, p = .083$ . The relatively high percentage in the Danes, which reflects the opposite pattern of that seen in Fukushima flashbulb memories,

**Table 2.** Descriptive statistics and results of one-way analysis of variance tests for the Fukushima event features among all participants in Study 1.

	German ( <i>n</i> = 105)		Dutch ( <i>n</i> = 105)		Danish ( <i>n</i> = 50)		<i>F</i> (2, 257)	<i>p</i>	partial $\eta^2$
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Surprise	4.80	1.76	4.57	1.75	4.16	1.66	2.31	.10	.02
Personal Importance	3.54	1.32	2.53	1.27	2.14	1.31	25.59	<.001 <sup>a</sup>	.17
Family & Friend Importance	3.71	1.18	2.91	1.32	2.40	1.36	20.82	<.001 <sup>a</sup>	.14
National Importance	4.45	1.18	3.69	1.22	3.08	1.24	23.96	<.001 <sup>a</sup>	.16
International Importance	5.43	0.82	5.30	0.98	5.14	1.16	1.59	.21	.01
Political Consequences	5.18	0.93	4.46	1.08	4.42	1.51	13.47	<.001 <sup>a</sup>	.10
Environmental Consequences	5.92	1.05	5.01	1.46	5.28	1.50	12.98	<.001 <sup>a</sup>	.09
Economic Consequences	5.05	1.04	4.54	1.19	4.56	1.42	5.59	.004 <sup>a</sup>	.04
Consequences to Daily Life	2.34	1.33	1.56	0.91	1.22	0.51	24.45	<.001 <sup>a</sup>	.16

<sup>a</sup>Indicates statistical significance after accounting for multiple comparisons using the Benjamini Hochberg procedure.

increases our confidence that our participants were familiar with the flashbulb memory phenomenon. Relatedly, Germans do not seem to be generally more likely to report flashbulb memories overall. Thus, the differences seen for Fukushima flashbulb memories are unlikely to be due to an artifact of that type.

The other events<sup>3</sup> identified by participants as leading to their flashbulb memories generally fit categories seen in previous flashbulb memory studies: terrorist attacks/mass shootings, political events, natural disasters, airline crashes, deaths of celebrities, sporting events, and personal tragedies. Whereas most events were mentioned by fewer than five people, there were some exceptions. The terrorist attacks of 9/11 in the U.S. ( $n = 19/66$ , 29% German;  $n = 10/73$ , 14% Dutch; and  $n = 11/44$ , 25% Danish) and at the Bataclan club in Paris (2015), ( $n = 15$ , 23% German;  $n = 20$ , 27% Dutch; and  $n = 3$ , 7% Danish) were the most frequently mentioned events among those who identified another flashbulb memory. There was also a marked recency effect across all groups, with 14 (21%) German, 12 (16%) Dutch, and 8 (18%) Danish participants identifying the election of Donald Trump as U.S. President to be their 'other' flashbulb memory event.<sup>4</sup>

Further, even with somewhat low absolute frequencies, the relative frequencies of events identified reveal some interesting cross-national patterns. There were five events with particular relevance to German participants (i.e. Berlin Christmas market attack, Munich attack, Winnenden shooting, Germanwings 9525 crash, and the 2014 World Cup Soccer victory) and these were identified by five (8%) Germans, three (4%) Dutch, and zero Danish participants. There were three events of particular relevance to Dutch participants (i.e. shooting down of Malaysian Airlines flight MH-17, attack on the Dutch Royal family, and the assassination of politician Pim Fortuyn). Fifteen (21%) Dutch participants reported flashbulb memories for these events whereas only one (2%) German participant reported a flashbulb memory for the shooting of flight MH-17 and no Danish participant mentioned any of these events. Lastly, the Utøya massacre in Norway was mentioned by 13 (30%) Danish participants but no one from the other two countries. To be clear, these were events spontaneously mentioned by participants when asked if there was any other "public event, recent or remote, for which you remember exactly where you were and what you were doing when you learned of that news?" Therefore, it may be the case that participants would respond in the affirmative if specifically asked whether they had flashbulb memories for each specific event.

## Discussion

When asked more than five years after the incident, German participants were more likely to have flashbulb memories of the Fukushima Daiichi nuclear disaster than were Dutch or Danish participants. German participants rated the Fukushima disaster as more important and

more consequential across nearly all dimensions than did the other groups. Although the Germans rated the national importance of the event most highly, the Danes rated the Fukushima disaster as less important to Denmark than did the Dutch for the Netherlands. This finding is consistent with the idea that nuclear energy is a less important political and social topic for the Danes than it is for the Dutch. Similarly, although there was, at most, moderate support for nuclear energy in our samples, the pattern among our groups is consistent with relatively more support among Dutch participants and more opposition among German participants. Furthermore, when asked to identify any flashbulb memory, those most accessible examples also differed as a function of social group membership.

However, the age of the participants in this study may have led to an underestimation of flashbulb memory formation. Many participants would have been adolescents at the time of the event raising some potential concerns. First, even though individual reports (especially of Germans) indicated that the disaster had been a topic of discussion in high school classes, as a whole, young people may have been less attuned to political events at that age and this may have reduced the frequency of flashbulb memories in the sample. Relatedly, their political opinions may have changed a great deal in the intervening years making retrospective judgments more tenuous in participants of this age than in older participants with presumably more stable ideologies. Also, due to the differential compensation available to participants in each group (i.e. Dutch and German participants were able to earn course credit for participation whereas Danish participants were all volunteers), the Danish sample was notably smaller than the other two groups. This limits our ability to draw strong conclusions about comparable flashbulb memory frequency between the Danish group and the other two groups. Therefore, we replicated (and extended) the study in a new sample, specifically addressing both of these concerns.

## Study 2

### Method

#### Power analysis

A power analysis using G\*Power 3.1.9.2 (Faul, Erdfelder, Lang, & Buchner, 2007) showed that sample sizes of 161 per group provide .95 power to detect medium effect sizes of  $d = 0.5$  with an alpha at .005 in *a priori* independent samples t-tests. We adjusted alpha to account for Type I error inflation inherent in conducting multiple tests with flashbulb memory characteristics and event features. Note that the planned sample size of  $N = 480$  exceeds those necessary to detect medium effect sizes with an alpha of .005 at .95 power in omnibus one-way ANOVA calculations ( $f = .25$ ; total necessary sample, 372) and chi-square goodness-of-fit tests ( $w = .30$  total necessary sample, 365).



## Participants

Participants were recruited from Qualtrics Online Sample during the fall of 2018. Ethics board approval was obtained from the questionnaire-hosting institution (Lafayette College). All respondents were compensated by Qualtrics via an internal point system where points are redeemable for airline miles, gift cards, etc. in local markets (approximately \$3 USD per participant).

A total of 2,421 participants began the questionnaire, but the majority were excluded for being outside the age, gender, and/or nationality parameters or for providing incomplete responses (German = 791, Dutch = 674, and Danish = 265). Others were excluded because they skipped more than two rating-scale questions, they missed catch trial(s), they provided nonsense responses to the open-ended Fukushima flashbulb memory questions, and/or their response to the "Other flashbulb memory" question was not valid. In addition to pre-set criteria (see <https://osf.io/hpkwj/registrations>), we excluded participants who were not living in the country during the time of the Fukushima nuclear disaster and/or who gave the same response to all items within a given block of rating-scale questions. Importantly, we decided to extend the exclusion criteria before data-analysis and recruited replacements from Qualtrics. Of the 518 participants included in the final analysis, 183 (including 73 men) were from Germany, 172 (67 men) were from the Netherlands, and 163 (61 men) were from Denmark.

Our agreement with Qualtrics stipulated that all participants be born between 1961 and 1991 (with roughly equal distribution from each decade of birth) and each nationality group would be approximately 40:60 male:female. A description of the distribution of participants across strata can be found in Supplemental Materials available from <https://osf.io/hpkwj>.

## Preregistration details and availability of materials and data

The design and procedure was identical to Study 1: a one-way between-groups design comparing questionnaire responses across the three nationality groups. The method and analysis plan were preregistered before the start of data collection at <https://osf.io/hpkwj/registrations/>. The materials and data for study 2 are publicly available from <https://osf.io/hpkwj/>. We report all measures and data exclusions.

## Questionnaire and procedure

The online instrument included an informed consent page at the outset and a debriefing statement upon completion.

The first three blocks (dichotomous flashbulb memory questions for Fukushima and "another public event", the nine probed recall questions for canonical details of their memory for hearing of the Fukushima disaster (when applicable), and the 7-point rating-scales regarding

phenomenological and metacognitive aspects of their memory) were unchanged from Study 1.

Notably, two additional questions on consistency of the event with prior beliefs were added to the block of questions assessing how surprising, important, and consequential the Fukushima disaster itself was. Immediately after rating how surprised participants were by the event, they were asked "How consistent was Fukushima with *your personal expectations* that something like this would happen?" and "How consistent was Fukushima with *the average [nationality] person's* expectations that something like this would happen?" These questions allow us to more directly address the role of congruence in flashbulb memory formation.

We also repeated the block of event assessment questions for those participants who self-nominated another flashbulb memory. Depending on the nature of those events (i.e. the frequency that the same event is identified in all three samples and/or the frequency of nationality-specific events), exploratory analysis of relevance and congruence can be computed for these flashbulb memories as well.

Finally, the two catch trials from Study 1 were retained as were the demographic questions.

## Results

### Flashbulb memory formation for the Fukushima disaster by nationality group

First, there was a significant association between nationality and flashbulb memories of the Fukushima nuclear disaster as operationally defined as responses to the dichotomous self-report question,  $\chi^2(2, N = 518) = 6.30, p = .04$ . We carried out planned comparisons with adjusted alphas according to a sequential Bonferroni procedure. Germans (31%,  $n = 57/183$ ) were statistically significantly more likely to have Fukushima flashbulb memories than were Danes (20%,  $n = 32/163$ ),  $\chi^2(1, N = 346) = 5.98, p = .014, \alpha_{adj} = .0167$ . The difference between the Germans and the Dutch (24%,  $n = 41/172$ ) was not statistically significant,  $\chi^2(1, N = 355) = 2.37, p = .12, \alpha_{adj} = .025$ . The frequency of Fukushima flashbulb memories was not significantly different for Dutch and Danish participants,  $\chi^2(1, N = 335) = .87, p = .35, \alpha_{adj} = .05$ .

Responses to the nine probed recall questions were coded to determine which canonical details were present. The second and third authors independently coded responses from German participants and agreement with each canonical category was high ( $M = 93\%$ , lowest was 82% for responses to the emotional reaction question, perfect agreement was found for questions regarding how participants learned the news, where they were, and who they were with). Disagreements were resolved through discussion and then the second author coded all Danish responses and the third author coded all Dutch responses independently. Participants with flashbulb memories remembered on average 7.23 canonical categories (range

0–9;  $SD = 1.59$ ), indicating that the memories were quite detailed (see Table 3). A priori Welch  $t$ -tests showed that the average number of canonical categories did not statistically significantly differ between nationality groups,  $t_{\text{welch}}(68.03) = .83$ ,  $p = .41$  for Germans vs. Dutch,  $t_{\text{welch}}(43.67) = .95$ ,  $p = .35$  for Germans vs. Danes, and  $t_{\text{welch}}(60.28) = .26$ ,  $p = .80$  for Dutch vs. Danes.

#### *Fukushima flashbulb memory characteristics by nationality group*

According to G\*Power 3.1.9.2, the actual number of participants with Fukushima flashbulb memories ( $N = 130$ ) should yield 90% power to detect a large effect size of at least  $f = .4$  with an alpha of .005 in a one-way between-subjects ANOVA.<sup>5</sup> However, because the group sizes were unequal, this is most likely an overestimation. A similar post-hoc power analysis based on the smallest group size ( $n = 32$  Danes, total  $N = 96$ ) yielded approximately 75% power and this is likely an underestimation. Nevertheless, we accepted the 10%–25% risk of missing a true difference in favour of controlling false positive rates. Therefore, we decided to proceed with statistical analyses of group differences in phenomenological and metacognitive characteristics of the flashbulb memories (see Table 3), using the Benjamini Hochberg procedure for adjusting alpha levels (see Cramer et al., 2016). The one-way ANOVAs for emotional valence, overt and media rehearsal were statistically significant. According to a Tukey HSD test, Germans felt significantly more negatively about the Fukushima nuclear disaster than the Danes, who felt significantly more negatively than the Dutch. As for rehearsal, according to Tukey HSD tests, Danes were significantly less likely to talk about or engage with media reports about the Fukushima nuclear disaster than were Dutch or German participants (who did not differ significantly from each other).

#### *Fukushima event features by nationality group*

As outlined in our preregistered analysis plan, we also examined whether national groups would differ in their ratings of event features. To do so, we conducted a series of between-subjects one-way ANOVA on ratings of surprise, congruence, importance, and consequentiality (see Table 4). After correcting for multiple comparisons using

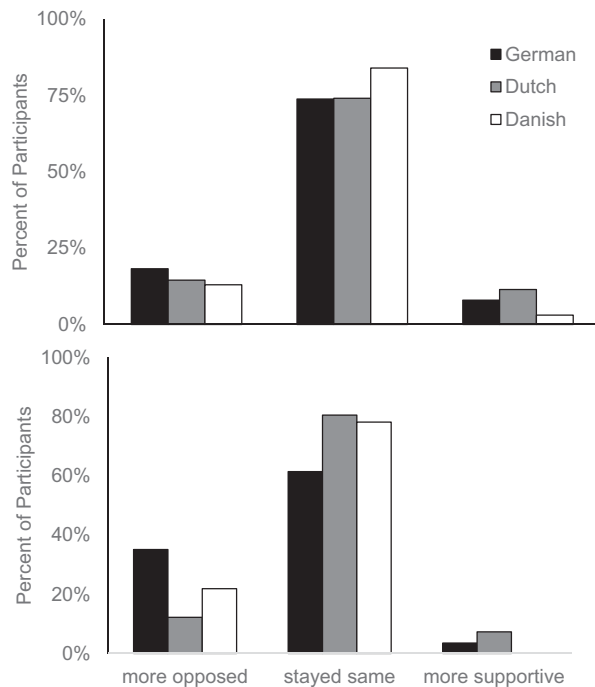
the Benjamini Hochberg procedure, the one-way ANOVA for personal importance, importance to one's friends and family, and national importance as well as for political consequences and consequences to daily life were statistically significant. According to a Tukey HSD test, Germans rated the personal importance and the importance of the event to their family and friends as significantly higher than the Danes, but the Dutch participants' ratings were not significantly different from either group. For national importance, the Danish ratings were significantly lower than the Dutch which were significantly lower than the German. For consequentiality, Germans rated the political consequences as significantly higher than the Dutch or Danish participants (who were not different from one another). Germans also rated the consequences of the event to their daily life as significantly higher than the Dutch who, in turn, rated those consequences more highly than did the Danes.

Surprisingly, the nationality groups in this sample did not statistically significantly differ in their support for nuclear energy either prior to or after the Fukushima disaster,  $F(2, 515) = .01$ ,  $p = .99$ ,  $\eta_p^2 = .00$  and  $F(2, 515) = 1.24$ ,  $p = .29$ ,  $\eta_p^2 = .00$  for ratings prior to and after the Fukushima disaster, respectively. Dutch participants (prior:  $M = 1.95$ ,  $SD = .82$ ; after:  $M = 1.91$ ,  $SD = .85$ ) were not significantly different from Danish (prior:  $M = 1.94$ ,  $SD = .98$ ; after:  $M = 1.81$ ,  $SD = .97$ ) nor German (prior:  $M = 1.95$ ,  $SD = .88$ ; after:  $M = 1.76$ ,  $SD = .87$ ) participants, who were not significantly different from one another. Because we have more flashbulb and non-flashbulb memory responses from the current samples than in Study 1, we explored whether participants with vs. without flashbulb memories for the Fukushima disaster differed in their retrospective evaluations of whether their support for nuclear energy changed as a function of the disaster. To do so, we computed a difference score for each participant where their rating of support for nuclear energy prior to the disaster was subtracted from their rating of support after the disaster. Participants' absolute support or opposition is irrelevant here, only their relative change is captured by this measure. A score of zero therefore indicates that the Fukushima nuclear disaster did not change their support for nuclear energy. All other scores were collapsed such

**Table 3.** Descriptive statistics and results of one-way analysis of variance tests for the phenomenological and metacognitive characteristics among participants reporting flashbulb memories for the Fukushima nuclear disaster in Study 2.

	German ( $n = 57$ )		Dutch ( $n = 41$ )		Danish ( $n = 32$ )		$F(2, 127)$	$p$	partial $\eta^2$
	$M$	$SD$	$M$	$SD$	$M$	$SD$			
Vividness	3.74	1.06	4.05	1.38	3.56	1.65	1.30	.28	.02
Reliving	3.02	1.28	3.68	1.51	3.09	1.63	2.77	.07	.04
Belief in Accuracy	4.75	1.27	4.37	1.24	4.50	1.65	1.02	.36	.02
Emotional Valence	1.77	1.15	3.68	1.25	2.94	1.13	32.44	<.001 <sup>a</sup>	.34
Emotional Intensity	3.88	1.35	3.49	1.34	3.09	1.59	3.24	.04	.05
Significance	3.37	1.53	3.20	1.52	2.50	1.50	3.46	.03	.05
Covert Rehearsal	2.89	1.33	3.27	1.43	2.47	1.16	3.27	.04	.05
Overt Rehearsal	3.96	1.56	3.27	1.27	2.28	0.96	16.21	<.001 <sup>a</sup>	.20
Media Rehearsal	3.98	1.43	3.66	1.13	2.66	1.31	10.62	<.001 <sup>a</sup>	.14
Canonical Categories	7.40	1.21	7.15	1.70	7.03	2.02			

<sup>a</sup>Indicates statistical significance after accounting for multiple comparisons using the Benjamini Hochberg procedure.



**Figure 1.** Frequency distribution of support for nuclear energy ratings after – prior to the Fukushima disaster for participants without (top panel) and with (bottom panel) flashbulb memories for that event in Study 2 as a function of nationality.

that scores below zero were classified as “more opposed” and scores above zero were classified as “more favorable.” Again, absolute support is irrelevant as is degree of change; a participant who moved from “somewhat opposed” to “strongly opposed” and someone who moved from “somewhat favor” to “strongly opposed” would both be categorised as “more opposed.” In all three nationality groups, most participants’ opinions were unchanged by Fukushima. However, as shown in Figure 1, Germans were more likely to say that their opinion of nuclear energy was less favourable after Fukushima, especially among those who had a flashbulb memory for hearing about the disaster,  $\chi^2(2, N = 183) = 6.77, p = .03$ . There was no such association between having a flashbulb memory and changed support for nuclear energy for Dutch ( $\chi^2(2, N = 172) = .80, p = .67$ ) or Danish ( $\chi^2(2, N = 163) = 2.47, p = .29$ ) participants.

### Non-Fukushima flashbulb memories

Most participants reported non-Fukushima flashbulb memories, but this too differed as a function of nationality in this sample,  $\chi^2(2, N = 518) = 7.73, p = .02$ . Importantly, Germans were less likely to respond affirmatively (53%,  $n = 97/183$ ) compared to the Dutch (66%,  $n = 114/172$ ) or Danes (64%,  $n = 105/163$ ).

The other events identified by participants as leading to their flashbulb memories were similar to those reported in Study 1 and previous flashbulb memory studies generally. The terrorist attacks of 9/11 in the U.S. were, by far, the most commonly identified event ( $n = 74, 76\%$  German;  $n$

$= 81, 71\%$  Dutch; and  $n = 76, 72\%$  Danish); no other event was identified by more than 10 people. Descriptive statistics for the ratings of event features for flashbulb memories of 9/11 as a function of nationality group can be found in Supplemental Materials available from <https://osf.io/hpkwj>. Similarly, we saw cross-national patterns in this sample that are suggestive of the important role social group membership plays in flashbulb memory formation. As in Study 1, only Danish participants ( $n = 3, 3\%$ ) mentioned the Utøya massacre. Similarly, each nationality group had a small number of events that were particularly relevant to members of that country and were only mentioned by participants from that country.<sup>6</sup>

### Discussion

Consistent with our hypothesis that social group membership is associated with flashbulb memory formation for the Fukushima nuclear disaster, and replicating what we found in Study 1, Germans were most likely to report flashbulb memories for the Fukushima disaster. Also replicating the results of Study 1, there was no significant difference among groups on ratings of surprise or international importance but there were differences on several ratings of importance and consequentiality. Germans rated the political consequences as significantly higher than the Dutch or Danish participants, reflecting awareness in this sample of the role the Fukushima disaster played in revising German government policy to reduce reliance on nuclear energy. Germans also rated the consequences of the event to their daily life as significantly higher than the Dutch who, in turn, rated those consequences more highly than did the Danes supporting our hypothesis that the Fukushima event would be most influential for the Germans, less so for the Dutch, and least for the Danes. Yet, surprisingly, our two direct questions regarding the congruence of the Fukushima event with personal and public expectations showed no significant differences among the nationality groups.

As in Study 1, most participants reported non-Fukushima flashbulb memories and German participants were not significantly more likely to do so. This reduces the likelihood that some baseline differences in familiarity with or willingness to report flashbulb memories among the nationality groups could provide an alternate account for our findings. There were, however, interesting differences between Study 1 and Study 2 in the self-selected flashbulb memories participants reported. Notably, there were much higher rates of reporting flashbulb memories for the 11 September attacks in the U.S. in Study 2, an event which most participants in Study 1 were too young to have remembered. Also, there were much higher rates of flashbulb memories for the election of Donald Trump as U.S. President in Study 1; as only two participants in Study 2 identified this event. This is likely to have been a recency effect in Study 1 as the election itself occurred during the data collection period.

**Table 4.** Descriptive statistics and results of one-way analysis of variance tests for the event features among all participants in Study 2.

	German ( <i>n</i> = 183)		Dutch ( <i>n</i> = 172)		Danish ( <i>n</i> = 163)		<i>F</i> (2, 515)	<i>p</i>	partial $\eta^2$
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Surprise	4.32	2.13	4.77	1.81	4.42	1.74	2.73	.07	.01
Personal Congruency	3.84	1.93	3.68	1.73	4.17	1.53	3.35	.04	.01
Public Congruency	3.72	1.63	3.47	1.53	3.75	1.42	1.75	.17	.01
Personal Importance	3.44	1.43	3.10	1.55	2.93	1.50	5.27	.005 <sup>a</sup>	.02
Family & Friend Importance	3.29	1.55	2.96	1.49	2.75	1.42	5.83	.003 <sup>a</sup>	.02
National Importance	3.98	1.47	3.52	1.33	3.02	1.45	20.07	<.001 <sup>a</sup>	.07
International Importance	4.57	1.53	4.87	1.18	4.50	1.39	3.57	.03	.01
Political Consequences	4.44	1.53	3.75	1.36	3.64	1.59	14.69	<.001 <sup>a</sup>	.05
Environmental Consequences	5.02	1.63	4.98	1.58	5.01	1.56	.04	.96	.00
Economic Consequences	4.49	1.60	4.23	1.33	4.63	1.47	3.20	.04	.01
Consequences to Daily Life	2.89	1.56	2.42	1.46	1.91	1.26	20.17	<.001 <sup>a</sup>	.07

<sup>a</sup>Indicates statistical significance after accounting for multiple comparisons using the Benjamini Hochberg procedure.

Also noteworthy is that, in the context of a questionnaire explicitly asking about the Fukushima nuclear disaster, only German participants (*n* = 5, 5%) described a flashbulb memory for the 1986 Chernobyl nuclear disaster. Given how few events were mentioned by more than one participant overall, and taking into account that only older participants would have had the opportunity to encode this event of more than 30 years ago, this seems to suggest that Germans are more attentive to, and therefore more likely to remember, events related to nuclear energy than are the other two groups. Given that nuclear power is relevant to Dutch political policy, it is somewhat surprising that they were not primed to generate flashbulb memories of a previous nuclear disaster. This may suggest that resonance with social group schema, not just relevance, is important.

## General discussion

When asked more than five years after the incident, German participants were more likely to have flashbulb memories of the Fukushima Daiichi nuclear disaster than were Dutch or Danish participants. It is remarkable that 17% of the German participants in Study 1 and 31% in Study 2 had flashbulb memories for the Fukushima disaster in Japan five years after its occurrence, while only 14% of Japanese were found to have flashbulb memories one year after the 1999 Tokaimura nuclear accident, which was, at the time, the most severe nuclear accident in Japan (Otani et al., 2005). The question, then, is why do Germans for whom this event is physically remote and not directly influential, retain vivid recollections of hearing the news?

Event features thought to predict flashbulb memory formation are themselves influenced by social group membership. Consistent with appraisal theory, an objective event requires subjective interpretation before an emotional reaction and/or subsequent cognitive processing. Although “newsworthy” public events certainly share some objective attributes, those features in-and-of-themselves are not determinative of individual memories. Larsen (1992) showed enhanced retention for news

events that were personally relevant relative to other, equally “newsworthy” reports. Talarico and Rubin (2017) have argued that consequentiality as defined objectively (e.g. by number of lives lost in a natural disaster) is less influential in flashbulb memory formation than is personal significance defined subjectively (e.g. by self-report measures of personal importance). One example of how personal importance can influence flashbulb memory formation is that the second author remembers exactly where she was and what she was doing when she heard about the Fukushima disaster due, in no small part, to the fact that the event took place on her birthday. This example illustrates the importance of personal significance in determining which public events result in flashbulb memories.

Because social group membership is, in part, how we determine personal relevance, the evidence in support of group differences in flashbulb memory formation is consistent across a number of defining group features, including race (Brown & Kulik, 1977), gender (Wright, Gaskell, & O’Muircheartaigh, 1998), language (Stone, Mercy, Licata, Klein, & Luminet, 2013), religion (Curci, Lanciano, Maddalena, Mastandrea, & Sartori, 2014; Lanciano, Curci, & Soleti, 2013; Tinti, Schmidt, Sotgiu, Testa, & Curci, 2009), and membership in political groups (Bohn & Berntsen, 2007) or social movements (Berntsen & Thomsen, 2005). Here, both younger and middle-aged samples of German participants rated the Fukushima disaster as more personally important, more important to their friends and family, of greater national importance, and of greater political consequentiality than the other two national groups.

Unexpectedly, although Dutch participants were more supportive of nuclear energy than were the Danes or Germans in Study 1, this was not the case in Study 2. However, Germans, especially those who had a flashbulb memory for learning about the disaster, were more likely to say that their opinion of nuclear energy was less favourable after Fukushima. However, this suggestion came from exploratory analyses and the extent to which they represent a genuine effect is unknown. It will be interesting to see whether an association between attitude change and flashbulb memories can be confirmed in



future research. More generally, because these are retrospective self-reports, confidence in whether these are accurate reflections of participants' true beliefs at the time should be tempered. Also surprising was that neither measure of congruence with prior beliefs in Study 2 differed as a function of nationality group. It may be that these newly developed items were insufficiently sensitive to detect differences in congruence, or, it could be that something other than congruence differs among them.

Importantly, ratings of national importance, overt rehearsal, and media rehearsal were higher among Dutch participants than Danes in Study 2. This finding is consistent with the idea that nuclear energy is a less important political and social topic for the Danes than it is for the Dutch. Yet, the Dutch participants' responses were frequently not different from those of Danish participants. These inconsistencies suggest that relevance alone cannot explain the differences in flashbulb memories across social groups. Thus, even if the results with respect to congruency were inconclusive, given the other findings as well as the theoretical model (Berntsen, 2009) it seems worthwhile for future studies to pursue this issue further.

Identifying which events are most likely to lead to flashbulb memories among which populations remains an important question in the field. Tinti et al. (2009) found that although religiosity and nationality independently predicted flashbulb memory formation for the death of Pope John Paul II, it was among Polish participants who identified with the Pope on both factors who were most likely to have vivid and consistent flashbulb memories. Like our German participants, Tinti et al.'s Polish participants had the highest ratings of importance, consequentiality, negative emotional valence, and rehearsal via conversation and media reports relative to Italian and Swiss participants.

Here, individuals who had flashbulb memories also discussed these more with other people. Many flashbulb memory studies have found increased rehearsal to correlate with increased likelihood of flashbulb memories (e.g. Bohannon, 1988; Curci et al., 2001; Davidson & Glisky, 2002; Otani et al., 2005; Tekcan & Peynircioglu, 2002; Tinti, Schmidt, Testa, & Levine, 2014). Furthermore, studies of non-flashbulb autobiographical memory have shown that repeated overt retrieval attempts lead to more consistent and more elaborated reports (Campbell, Nadel, Duke, & Ryan, 2011; Nadel, Campbell, & Ryan, 2007). Conversational norms dictate that a speaker infer a listener's potential interest in a given topic. But, interest alone is insufficient, appropriateness for the audience (and/or venue) is also necessary. In both studies, Germans rated Fukushima as relatively important to their small-scale social group of friends and family whereas Danes rated it as less important. Those global assessments are reflected in the overall frequency of flashbulb memory reports in each group. This suggests that social rehearsal is particularly susceptible to confirmation bias. Speakers are less likely to begin conversations that may lead to disagreements or discomfort among the participants. In both

studies, German participants with flashbulb memories of Fukushima were more likely to report talking about those memories than were participants from other countries who also had flashbulb memories. Is the larger number of participants with flashbulb memories evidence of more willing conversational partners or is the greater likelihood of conversation responsible for increasing the numbers of individuals with flashbulb memories? Our data cannot speak to directionality, but it is likely that this is a mutually reinforcing cycle in everyday experience.

Overall, our findings are consistent with the growing body of literature that supports Berntsen's (2009) hypothesis that the greater relevance of an event to a social group, the greater the likelihood that individual members of a given social group will develop and maintain flashbulb memories for that event. What is most needed now is further study of what aspects of social identity and/or what functions of social groups are most important to this process. Even though the direct evidence for congruence is inconclusive in Study 2, future studies relying on more refined measures may further determine its importance. We have tried to emphasize that congruence with prior expectations may be one piece of the flashbulb memory puzzle.

## Notes

1. The literature does include examples of personal, directly experienced events that have sometimes been examined along with public events (e.g., Brown & Kulik, 1977; Demiray & Freund, 2015; Rubin & Kozin, 1984), or even as analogs to the more traditional disasters and political events (e.g., Talarico, 2009; Kraha & Boals, 2014). Furthermore, in studies examining physical proximity to an event, direct experience is often conflated with the nearest distance (e.g., Er, 2003; Neisser et al., 1996; Sharot, Martorella, Delgado, & Phelps, 2007). However, these are exceptions not the rule.
2. We excluded the substantially older participants because they might have perceived the events differently than the majority who were young adolescents at the time of the event. Running the analyses including the older participants yielded similar patterns of results. All three excluded participants reported no flashbulb memory for the Fukushima disaster and mentioned the events of 9/11 as their other flashbulb memory.
3. The description of the other flashbulb memory was missing for one Dutch participant.
4. Obviously, this option was not available to the 40 participants with another flashbulb memory ( $n = 28$  German, 11 Dutch, and 1 Danish) who completed the questionnaire prior to 9 November 2016.
5. The preregistration included a power analysis showing that 34 flashbulb memories per group would be sufficient to detect large effect sizes of at least  $f = .4$  with an alpha of .05 (not .005 as intended). We deemed controlling Type I error inflation as more important than preventing false negatives and therefore adjusted the alphas accordingly.
6. For Danish participants: the Roskilde Train disaster and when Denmark won the European soccer championship. For Dutch participants: the Enschede fireworks disaster, the shooting down of Malaysian Airlines flight 17, the Bijlmer plane crash and the assassination of politician Pim Fortuyn. For German



participants: the Munich attack, Love Parade disaster, Germanwings 9525 crash, and the fall of the Berlin Wall.

## Acknowledgements

Annette Bohn is supported by The Danish National Research Foundation (DNRF89). Funding for Study 2 data collection was provided by a Faculty Research Grant from the Academic Research Committee of Lafayette College. The authors would also like to thank two anonymous reviewers for their helpful suggestions and comments.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Funding

Annette Bohn is supported by The Danish National Research Foundation (DNRF89). Funding for Study 2 data collection was provided by a Faculty Research Grant from the Academic Research Committee of Lafayette College.

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